

6.—The Naturalised and Cultivated Species of *Lupinus* (Leguminosae) Recorded for Western Australia

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The identity of cultivated and naturalised species of *Lupinus* in Western Australia is discussed, and a key is provided for the identification of the 9 species considered. Since no original type specimens have been available for consultation, all remarks and conclusions are based on local material and published descriptions.

The "West Australian blue lupin," previously known in Australia either as *L. varius* L. or as *L. pilosus* L., is identified as *L. digitatus* Forsk. Its somatic chromosome number is 32.

Introduction

At least 9 species of lupins (*Lupinus* spp.) are known in Australia, either cultivated or as naturalised aliens. Of these, four or five could be classified as "agricultural," and are in the main confined to the agricultural areas of South-West Western Australia. The remaining species constitute the ornamental lupin varieties which are grown in the temperate parts of Australia. There are no indigenous lupins.

The nomenclature of these species has been a source of considerable confusion, probably arising from a lack of adequate available literature. Such keys as have been readily available have been mainly regional, and have not only been inadequate but in some cases contradictory. In the present paper an attempt is made to clear up this confusion in so far as it concerns the species occurring in Western Australia. Only those species known to be present are dealt with, although reference is made to others.

Identity of the "West Australian Blue Lupin"

Opinion in Australia has long differed on the diagnosis of this species. It was originally known as *L. pilosus* L. (Gardner and Elliot 1929), but this appears to have later changed to *L. varius* L., for it is by the latter name that the species has been known in more recent West Australian publications, e.g. Gardner and Bennetts (1956). However, Black (1948) calls it *L. pilosus*, and in the C.S.I.R.O. publication "Standardised Plant Names" (1953) preference is given to this name also.

A study of the literature has revealed some disagreement among European botanists. Nevertheless, it is plain that *L. varius* differs from the West Australian blue lupin in several important characters. Three of the most clear-cut are as follows:

- (1) *L. varius*: lower flowers of raceme tend to be alternate, upper flowers verticillate; W.A. Blue: all flowers verticillate.

- (2) *L. varius*: upper lip of calyx 2-toothed only; W.A. blue: upper lip deeply 2-partite.

- (3) *L. varius*: upper surface of leaflets glabrous or glabrescent, lower surface hairy; W.A. Blue: both surfaces hairy.

These three points appear consistently in the descriptions of *L. varius* seen (those of de Candolle 1825, Hegi 1923, Chevalier and Trochain 1937), and allow the conclusion to be reached with reasonable certainty that the West Australian blue lupin is not the same species as *L. varius*. It corresponds rather to the species described in 1828 by Gussone as *L. cosentini* Guss., not only as regards the three characters listed above, but also as regards a number of others. There is little doubt that the two are identical. Gussone's description is, however, antedated by that of Forskal (1775), who named it *L. digitatus* Forsk. Unfortunately, the latter description is not a very full one, and it is inaccurate in describing the species as a perennial, as pointed out by Boissier (1872). Nevertheless, the synonymy of the two appears to be agreed upon (Boissier 1872, Fiori 1925, Zhukovsky 1929), although there has been no general accord on the matter of priority, and both names appear in the literature with similar frequency. If it can be assumed that they are in fact synonyms, however, *L. digitatus* must take priority since it is the earlier, and it follows that from the evidence available the West Australian blue lupin should be known as *L. digitatus* Forsk.

Malheiros (1942) found a somatic chromosome number of 32 for *L. digitatus* (as *L. cosentini*), which is the only record in the literature of this number in a *Lupinus* species. Counts by the present author have shown that the somatic chromosome number of the West Australian blue lupin (Accession N. 2086) is likewise 32, which provides additional evidence in favour of the above identification, although it cannot be regarded as conclusive since not all the chromosome numbers within the genus are known.

The very similar species *L. pilosus* Murr. can be shown to differ from *L. digitatus* in several characteristics, although there has been no general agreement that the two are distinct species. It should be noted that the author of *L. pilosus* is J. A. Murray, who edited the 13th edition of Linnaeus' "Systema Vegetabilium" (1774). Authority is often attributed to Linnaeus.

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Coste (1901) described *L. pilosus* and *L. cosentini* as being synonymous. More recently Chevalier and Trochain (1937) are emphatic on this point. On the other hand, Agardh (1835) and Boissier (1872) make a specific distinction between the two. Some writers are of the opinion that *L. digitatus* (or *L. cosentini*) should be classified as a sub-species of *L. pilosus*. Thus Fiori (1925) calls it *L. pilosus* Murr. Ssp. *cosentini* (Guss.), but Zhukovsky (1929) re-names it *L. pilosus* L. Spp. *digitatus* (Forsk.) Zhuk., the *digitatus* replacing *cosentini* for priority reasons.

It can readily be demonstrated, however, that *L. pilosus* and *L. digitatus* are distinct species, on the following grounds:

(i) The two can be consistently distinguished on traditional taxonomic characteristics.

(ii) Numerous attempts by the author at artificial crossing between the two have been unsuccessful. In the *L. digitatus* × *L. pilosus* cross, pods were formed which in every case contained only empty and shrivelled seed coats, whereas artificial self-pollination of these species regularly produces good seed. In the *L. pilosus* × *L. digitatus* cross there was no sign even of pod formation.

(iii) The chromosome numbers are different. For *L. pilosus* two counts are recorded in the literature. Savchenko (1935) found a somatic chromosome number of 40, and Tuschnjakowa (1935), 42. The writer has confirmed the latter number of 42 (for accession N. 1999), and has found, as mentioned above, 32 somatic chromosomes in *L. digitatus*.

Apart from *L. pilosus*, at least two other species appear to be similar to *L. digitatus*. *L. palaestinus* Boiss. (1849) differs in that the flowers are yellow tinged with blue and the pedicels scarcely shorter than the calyx, as against blue flowers with pedicel only about one-third the length of the calyx. The recently described species *L. tassilius* Maire (1933), which is native to parts of the Western Sahara and Senegal, has alternate or sub-alternate flowers, as against verticillate flowers, but otherwise appears to be very similar (Chevalier and Trochain 1937).

Identity of Other Species

The true *L. pilosus* Murr. is sometimes found in Western Australia but has generally been reported as *L. hirsutus* L. (e.g. Thomas and Shier 1925). The misidentification comes about presumably on account of its hairiness. Some confusion may also have been occasioned by the fact that the flowers were originally described by Murray as being pink. In the wild state the species is usually, perhaps always, blue flowered. In cultivation, however, other colours are common, particularly pink, so it is quite probable that it was from one of these cultivated varieties that the original description was made.

A species for which alternative names are used in Australia is *L. albus* L., which is often known as *L. termis* Forsk. The differences by which the two were separated in some of the older keys, namely the presence or absence of bracteoles and the degree of blue tinting of the

corolla, are now regarded as being no more than varietal differences, and the two are normally brought together under the earlier designation of *L. albus*.

Descriptions of *Lupinus* Spp. in Western Australia*

(i)—*L. mutabilis* Sweet, Brit. Flow. Gard. 2 t, 130 (1825)

L. cruckshanksii Hook. in Bot. Mag. 58 t, 3056 (1831)

L. mutabilis Lindl. in Bot. Reg. 18 t, 1539 (1832)

The largest of the annual ornamental species, reaching 0.5-1.5 m, moderately branching, with stout hollow stem, becoming woody; glabrous or almost so except for pods. Leaflets 7-11, oblong-obovate. Raceme 10-30 cm in length, with a fairly long peduncle (6-17 cm). Flowers large and showy, verticillate in distant whorls, with long pedicels, falling rather readily; blue, white, pink or purple, with centre of standard always yellow at base; sweetly and pleasantly scented; height of flower 1.9-2.2 cm, length 1.7-2.0 cm. Bracts early deciduous; upper lip of calyx entire or 2-toothed at tip, lower lip entire and slightly longer. Pods downy, 7-10 cm long, 1.8-2.4 cm wide, with 4-6 large seeds. Seeds smooth and shiny, ovoid to slightly compressed, white, sometimes with brown markings, or brownish black in dark blue or purple flowered strains, 7-10 mm long, 6-8 mm broad. Strains also exist with slightly smaller pods and seeds.

Distribution—Originally from the mountainous regions of Peru, where it is cultivated to a limited extent for its seed. Grown in gardens; sometimes known as the "pearl" lupin. Seed of this species has also been received under the name *L. pantelericus* (accession N. 1996).

(ii)—*L. luteus* Linn., Sp. Plant. 721 (1753)

A rather spreading herbaceous annual 0.2-1.0 m tall, branching strongly from the base, covered with sub-appressed hairs 1-2 mm long. Leaflets 7-11, usually 8-9, oblong-obovate to linear-obovate, appressed hairy on both sides. Inflorescence 10-25 cm long on a peduncle 5-12 cm long. Flowers verticillate in rather distant whorls, bright golden-yellow, with a strong pleasant sweet scent; length and height of flower both about 1.6 cm; pedicel short, about 2 mm. Bracts obovate, deciduous; upper lip of calyx very deeply 2-partite, lower lip subequal, 3-toothed; bracteoles linear. Pods hairy, 5-6 cm long, 1.2-1.5 cm wide, with 4-6 seeds. Seeds smooth, compressed, 6-8 mm long, 5-7 mm wide, whitish with brown to black mottling, rarely almost black, or white in some improved varieties.

Distribution—Naturally occurring on sandy soils in the Western Mediterranean area: Tunisia, Algeria, Spain, Portugal, Corsica, Sar-

* In addition, the two species *L. varius* and *L. hirsutus* will be described from the literature, since although they are not known to occur in Australia they have in the past been confused with species which do. Apart from these two, descriptions are from populations of living material. Specimens are to be lodged with the W.A. State Herbarium.

dinia, Sicily and Italy. Widely and increasingly cultivated throughout Northern Europe: Holland, Sweden, Germany, Poland and Western parts of the U.S.S.R.; also in South Africa, New Zealand and Florida, on sandy soils for soil improvement and stock feed. Occasionally cultivated in Australia in gardens or very rarely for green manure. Naturalised in a few places south of Perth.

(iii)—*L. pilosus* Murr. in Linn., Syst. Veg. Ed. 13: 545 (1774)

A moderately branching annual reaching 0.4-1.0 m, stems densely covered with long silvery hairs 3-4 mm in length (plate 1. 1). Leaflets 9-11, obovate-oblong, about 3 times as long as broad, softly appressed-hairy on both surfaces. Inflorescences 20-30 cm long, subtended by a peduncle of 3-7 cm. Pedicel only a little shorter than calyx. Flowers verticillate, large, 2.0 cm long and 2.2-2.3 cm in height, dark blue; centre of standard white from base to upper margin, becoming deep purple with age; or flowers pink or white; faintly scented, scent spicy rather than sweet. Bracts lanceolate, deciduous; bracteoles linear-oblong, 4-5 mm long, 1 mm or more broad. Upper lip of calyx deeply 2-partite; lower lip longer, entire. Pods hairy, 5-8 cm long, 2.0-2.5 cm wide; seeds 2-4, usually 2-3, very large, 1.1-1.4 cm long, 1.0-1.2 cm broad, moderately compressed, very rough, mottled brownish-red with a broad blackish-red crescent around the hilum.

Distribution—Native or naturalised, comparatively rare, in Southern France, Corsica, Sardinia, Sicily, Greece, Palestine, Syria and Tunisia. Cultivated to a small extent in Europe, probably mainly as an ornamental plant. Occasionally seen in Western Australia in or escaped from gardens. Not to be confused with the American species *L. villosus* Willd., which is sometimes known as *L. pilosus* Walt.

(iv)—*L. digitatus* Forsk., Flor. Aegypt-Arab. 131 (1775)

L. cosentini Guss., Flor. Sic. Prod. 2: 398 (1828)

L. hirsutus Sieber ex Guss., Flor. Sic. Prod. 2: 399 (1828)

L. forskahlei Boiss., Diagn. Plant. Orient. (1) 9: 10 (1849)

L. pilosus Murr. ssp. *cosentini* (Guss.) Fiori, Nuov. Flor. Anal. Ital. 805 (1925)

L. pilosus L. ssp. *digitatus* (Forsk.) Zhuk., Bull. Appl. Bot. & Pl.—Br. 21: 263 (1929)

Similar to preceding species. Annual, rather bushy, 0.2-1.4 m in height. Stems and petioles covered with fine short erect white hairs, mostly about 1 mm or slightly less (Plate 1, 2). Leaflets 9-11, oblanceolate-oblong, 3.4-3.8 times as long as broad (except for earlier leaves, which are relatively shorter and broader), softly appressed-hairy on both surfaces. Inflorescences usually 10-20 cm long, subtended by a short peduncle, up to 4 cm. Flowers verticillate, smaller than

in preceding species, 1.5-1.7 cm in length, 1.8-1.9 cm in height, blue, with centre of standard yellowish white becoming purple with age; but white spot not extending to tip of standard as in *L. pilosus*; or flowers very rarely white, pale pink, or pale blue; not scented. Pedicel one-third length of calyx or less. Bracts lanceolate, deciduous; bracteoles linear, about 4 mm long and up to 1 mm wide; upper lip of calyx deeply 2-partite; lower lip longer, 3-toothed, 2-toothed or entire. Pods hairy, 4.5-6.0 cm long, 1.5-1.7 cm wide. Seeds 3-5, usually 4, 8-9 mm long, about 7 mm broad, moderately compressed, not more than half the size of those of preceding species, rough, mottly brown with blackish-brown markings, including a narrow crescent around the hilum.

Distribution—Occurs naturally in Portugal, Southern Italy, Sicily and Corsica, and common as a weed in fields of the Nile Valley. Cultivated in Palestine, and perhaps elsewhere in the Eastern Mediterranean region (?). Naturalised in Western Australia along a 400 mile coastal belt of sandy soils from north of Geraldton to south of Busselton, and there cultivated for sheep feed and soil improvement. Present also in South Australia.

(v)—*L. angustifolius* Linn, Sp. Plant. 721 (1753)

L. varius Savi, Fl. Pisan. 2: 178 (1798)

Annual; growth habit very erect, with profuse rather fine lateral branching, reaching 0.4-1.5 m; densely leafy; stems and petioles with sparse fine appressed hairs not more than 1 mm long. Leaflets 7-9, linear, dark green, glabrous above, appressed-hairy beneath. Inflorescence almost sessile; flowers alternate, 1.4-1.5 cm long, 1.2-1.4 cm in height, blue tinged with purple, particularly at tip of wings, or rarely pale blue, pink, pale pink, purple or white; not scented. Bracts oblanceolate-obovate, deciduous; bracteoles short, oblong. Upper lip of calyx rather short, very deeply 2-partite; lower lip much longer, entire or slightly 2-3-toothed. Pods 5-6 cm long, 1.5-1.6 cm wide; seeds 4-5, smooth, \pm spheroidal, 6-8 mm long and 5-6 mm wide, slate-grey with brown marbling and whitish spots, or rarely white, brown, black or intermediate colours.

Distribution—Native to almost every country bordering the Mediterranean. Widely cultivated in Holland, Sweden, Germany, Poland and the U.S.S.R.: also in South Africa, New Zealand and Florida, for soil improvement and latterly for stock feed. In Western Australia cultivated as a green manure crop and for sheep feed; also naturalised in the Swan Valley, near Perth, and southwards.

(vi)—*L. albus* Linn., Sp. Plant. 721 (1753)

L. termis Forsk., Fl. Aegypt.-Arab. 131 (1775)

L. sativus Gater., Desc. Pl. Montaub. 26 (1789)

L. varius Gaertn., Fruct. 2: 324 t. 150 (1791)

L. bivariorum Presl., Fl. Sic. 1: 24 (1826)

L. hirsutus Eichw., Casp. Cauc. 23 (1833)

L. thermis Gasp. in Atti. Acc. Nap. 6: 229 t. 10 (1851)

L. thermus St. Lag. in Ann. Soc. Bot. Lyon 7: 129 (1880)

An upright annual, 0.4-1.6 m in height, branching at flowering from base of peduncle; sparsely covered with white silky hairs 1-2 mm in length and \pm appressed. Leaflets 5-7 or 7-9, oblong-obovate, glabrous or glabrescent above, silky-hairy below, with ciliate margins. Inflorescence almost sessile; flowers alternate, sometimes approaching sub-verticillate towards apex of inflorescence, 1.6-2.0 cm long, white variably tinged with purplish blue, particularly on the wings; not scented. Bracts early deciduous; bracteoles small or absent; upper lip of calyx entire, lower lip entire or slightly 3-toothed. Pods large, 8-12 cm long, 2.0-2.5 cm broad; seeds 4-6, 0.9-1.4 cm long, \pm square, compressed, with a smooth surface and yellowish white in colour.

Distribution—Occurs in wild form in countries bordering the Mediterranean and in Ethiopia. Cultivated in these regions and in Argentina, Central Europe and parts of Southern U.S.S.R. as a grain legume. Very rare in Western Australia, but occasionally grown in districts near Bunbury.

(vii)—*L. hartwegii* Lindl. in Bot. Reg. 25 t. 31 (1839)

L. bilineatus Benth., Pl. Hartw. 11 (1839)

Erect growing annual, covered with long (3-7 mm) silvery hairs, 0.6-0.9 m in height, branching little until approaching flowering and then from well up the stem; stem stout, slightly hollow. Stipules long, 2-4 cm, linear-awl-shaped, hairy. Leaves a light green colour. Leaflets 7-9, oblong-obovate, hairy below, glabrous or nearly so above. Raceme up to 40 cm long, subtended by a very stout peduncle, and forming pods the whole way up. Flowers large, verticillate to alternate, not falling readily, dark blue, or pale blue, purple, pale purple or white; only faintly scented; height of flower 2.0-2.2 cm, length 1.9-2.1 cm. Bracts conspicuously long, linear, about twice the length of the fully developed bud, very hairy, deciduous. Calyx hairy, with linear bracteoles, upper lip entire to fairly deeply 2-partite, lower lip entire. Pods long and narrow, 4-6 cm long, 0.6-0.8 cm broad, with 7-10 seeds. Seeds small, 4.5 mm long, 3 mm broad, smooth, compressed, colour varying with that of flowers.

Distribution—A native of Mexico. Grown in gardens and known as the Hartwig or Hartweg lupin.

(viii)—*L. pubescens* Benth., Pl. Hartw. 169 (1844)

Dwarf to medium-sized annual, height 0.2-0.6 m, bushy, branching strongly from near base; covered with short fine hairs up to 1 mm in length. Stipules awl-shaped, 3-4 mm long. Leaflets 5-9, oblong-obovate, finely hairy below, glabrous or with sparse hairs above,

margins finely ciliate. Inflorescence 10-30 cm long, or only up to 10 cm in dwarf-growing varieties, subtended by a peduncle 4-12 cm long. Flowers verticillate to sub-alternate, usually blue to pink or pale pink with a pleasant sweet scent similar to that of *L. mutabilis*, 1.3-1.6 cm in height, 1.4-1.6 cm in length. Bracts lanceolate, early deciduous; calyx shortly furry, upper lip 2-partite or sometimes entire, lower lip entire. Pods 3-5 cm long, 1.1-1.4 cm broad; seeds 4-6, smooth, small, ovoid to oblong, 4-6 mm long, 3-4 mm broad, colour varying from white to dark brown.

Distribution—Native to Mexico and Guatemala, and widely cultivated for ornamental purposes.

Bailey (1949) states that a large number of the smaller cultivated annual lupin varieties are classified under *L. pubescens*, but that undoubtedly many of these are derived from interspecific crosses, natural or artificial. They are sometimes known as *L. hybridus*, and include the varieties *albococcineus*, *atrococcineus*, *californicus*, *dunnetti*, *duplex*, *elegans* and *tricolor* (these two probably from *L. pubescens* \times *L. polyphyllus* crosses), *guatemalensis*, *hybridus roseus*, *insignis*, *moritzianus*, *pulcherrimus*, *speciosus*, *succulentus*, *superbus*, *venustus*. *L. mutabilis* may enter into the ancestry of some, and perhaps other species as well. Inevitably, therefore, the group is very heterogeneous. The above description covers only the very limited number of dwarf garden varieties commonly grown in Australia.

(ix)—*L. polyphyllus* Lindl. in Bot. Reg. 13 pl. 1096 (1827)

L. macrophyllus Benth. in Sweet Brit. Flow. Gard. 7 t. 356 (1836)

A tall erect perennial, reaching 1.0-1.6 m. Stems woody, sparsely hairy to glabrous. Stipules awl-shaped, hairy; petioles long; leaflets 9-17, oblanceolate, glabrous or sparsely hairy above, appressed-hairy beneath, margins ciliate. Inflorescences very long, up to 60 cm, on peduncles 3-8 cm long; flowers numerous, 1.2-1.4 cm long, subverticillate, on long pedicels. Bracts awl-shaped, early deciduous; calyx short, lobes entire or finely serrated. Flowers dark blue, or light blue, pink, violet, white, or yellowish. Pods 2.5-4 cm long, 0.7-0.9 cm wide. Seeds 5-9, smooth, small, oblong, about 4 mm in length, variously coloured and spotted.

Distribution—Native to the West Coast of North America, from California to British Columbia. Cultivated as a green manure crop in Northern Europe, and widely in cooler climates as an ornamental plant, for which purpose it is particularly fine.

According to Bailey (1949), many of the ornamental varieties, including the Russell lupins, Downer's hybrids, Harkness hybrids and others, are in fact derived from interspecific crosses. The various flower colour types of the Russell lupin are descended from a *L. polyphyllus* \times *L. arboreus* cross.

(x)—*L. hirsutus* Linn., Sp. Plant. 721 (1753)

Fairly low-growing annual, 0.4-0.7 m, covered with long, spreading, rigid, rusty hairs. Leaflets 5-7, obovate-spatulate, coarsely hairy on both surfaces. Inflorescence short, oval, with upper flowers verticillate and lower ones alternate. Flowers blue, sometimes pink or white, corolla nearly twice as long as calyx; bracts awl-shaped, persistent; calyx bracteolate, upper lip deeply 2-partite, lower lip fairly deeply 3-toothed and twice as long. Pods densely rusty-hairy, with 3-4 seeds. Seeds smooth, greyish-brown with reddish spots and black lines on the margin.

Distribution—Native or naturalised in countries bordering the Mediterranean.

Gardner and Elliot (1929), and Gardner and Bennetts (1956) describe *L. hirsutus* as having been naturalised in Western Australia for many years, though probably restricted to the Geraldton-Northampton district, and as being known, together with *L. digitatus*, as the "West Australian blue lupin." The writer has never seen it, and samples of seed received from both the Western Australian Department of Agriculture and the C.S.I.R.O. Plant Introduction Section under the name *L. hirsutus* have all turned out to be in fact *L. pilosus*. It is probably the latter species to which Gardner refers, although his descriptions are clearly of the true *L. hirsutus*.

(xi)—*L. varius* Linn., Sp. Plant. 721 (1753)

L. sylvestris Lam., Fl. Franc. 2: 627 (1778)

L. semiverticillatus Desr. in Lam. Encycl. Meth. 3: 623 (1791-2)

A rather low-growing hairy annual. Leaflets very hairy on the lower surface but glabrous or glabrescent above. Flowers alternate at the base of the inflorescence but verticillate towards the top; corolla blue or rose, with a white spot on the standard. Upper lip of calyx 2-toothed only, lower lip slightly 3-toothed. Pods hairy, with 4-5 seeds. Descriptions of the seeds are contradictory.

Distribution—Native to the Iberian Peninsula and the Balaeric Islands, and said to be sometimes grown in gardens in Central Europe.

Key to *Lupinus* Spp. in Western Australia

- (a)—Seeds large, > 6 mm long; agricultural or ornamental species
 - (b)—Leaves and stems glabrous; ornamental (i) *L. mutabilis* Sweet
 - (b)—Leaves and stems sparsely to densely hairy
 - (c)—Flowers verticillate or almost so
 - (d)—Flowers golden yellow; seeds smooth . . . (ii) *L. luteus* Linn.
 - (d)—Flowers not yellow; seeds rough
 - (e)—Lower lip of calyx entire; hairs on stem about 3-4 mm long; seeds > 1 cm long, mottled reddish brown; pods with 2-3 seeds
 - (iii) *L. pilosus* Murr.

(e)—Lower lip of calyx often, but not always, 3-fid at tip; hairs on stem up to about 1 mm long; seeds < 1 cm long, dirty brown; pods with 3-5 seeds (iv) *L. digitatus* Forsk.

(c)—Flowers mostly alternate, seeds smooth

(d)—Leaflets linear, seeds \pm spheroidal (v) *L. angustifolius* Linn.

(d)—Leaflets oblong-obovate; seeds \pm square, compressed, white (vi) *L. albus* Linn.

(a)—Seeds small, < 6 mm long, smooth; ornamental species only

(b)—Leaflets 5-9; annuals

(c)—Erect habit, with long hairs (3-7 mm); bracts twice as long as the fully developed bud (vii) *L. hartwegii* Lindl.

(c)—Bushy dwarf or semi-dwarf habit; finely hairy; bracts shorter than fully developed bud (viii) *L. pubescens* Benth.

(b)—Leaflets 9-17; perennial

(ix) *L. polyphyllus* Lindl.

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References

- Agardh, J. G. (1835).—Syn. gen. Lup.
- Bailey, L. H. (1949).—"Manual of Cultivated Plants." (Macmillan: New York.)
- Black, J. M. (1948).—Fl. S. Aust., 2nd Ed. 2: 449.
- Boissier, E. (1849).—Fl. Orient. 2: 27.
- de Candolle, A. P. (1825).—Prod. Syst. Nat. 2: 406-10.
- Chevalier, A., and Trochain, J. (1937).—Histoire de trois lupins. Rev. Bot. appl. 17: 85-97.
- Coste, H. (1901).—Fl. descr. et illus. France 1: 307.
- C.S.I.R.O., Australia (1953).—"Standardised Plant Names." Bull. No. 272.
- Flori (1925).—Nuov. Fl. Ital. 1: 803-805.
- Forsk., P. (1775).—Fl. Aegypt. Arab. 131.
- Gardner, C. A., and Elliot, H. G. (1929).—The common blue lupin. J. Dep. Agric. W. Aust. (2) 6: 414-20.
- Gardner, C. A., and Bennetts, H. W. (1956).—"The Toxic Plants of Western Australia." (West Australian Newspapers Ltd.: Perth.)
- Gussone, Joanne (1828).—Fl. Sic. Prod. 2: 396-403.
- Hegi, G. (1923).—Fl. Mit. Eur. 4: 1154.
- Linnaeus, C. (1753).—Sp. Plant. 721.
- Linnaeus, C. (1774).—Syst. Veg. 13th Ed. 545.
- Malheiros, N. (1942).—Elementos para o estudo do genero *Lupinus*. Agron. lusit. 4: 231-36.
- Savchenko, P. F. (1935).—Karyology of some species of the genus *Lupinus*. Bull. Appl. Bot. Pl. Breed. (2) 8: 105-11. (Russ.)
- Thomas, I., and Shler, F. L. (1925).—Trials with imported varieties of lupins. J. Dep. Agric. W. Aust. (2) 2: 248-50.
- Tuschnjakowa, M. (1935).—Über die chromosomen einiger *Lupinus*-arten. Züchter 7: 169-74.
- Zhukovsky, P. M. (1929).—The genus *Lupinus* Tourn., Bull. appl. Bot. Pl. Breed. 21: 241-92. (Russ.)